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ABSTRACT

This study investigated the seating patterns of target students in science classrooms to see if there was an action zone or t-zone present. Fifty-six physical science and chemistry classes were observed using the Brophy-Good Teacher-Child Dyadic Observation System. Target students were identified and their interactions were compared to non-target students. Target student interactions for direct questions and student-initiated interactions were analyzed to ascertain whether the teacher or the student determined target student status. Results indicated that no t-shaped action zone was present in the classes observed. Target students dominated class interactions and received more direct questions, teacher afforded conversation and sustaining feedback. Nearly one-third of all students observed in the study did not interact at all and were silent. (Author)

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T-Zone, Target Students and Science Classroom Interactions

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Abstract

This study investigated the seating patterns of target students in science classrooms to see if there was an action zone or t-zone present. Fifty-six physical science and chemistry classes were observed using the Brophy-Good Teacher-Child Dyatic Observation System. Target students were identified and their interactions were compared to non-target students. Target student interactions for direct questions and student-initiated interactions were analyzed to ascertain whether the teacher or the student determined target student status.

Results indicated that no t-shaped action zone was present in the classes observed. Target students dominated class interactions and received more direct questions, teacher afforded conversation and sustaining feedback. Nearly one-third of all students observed in the study did not interact at all and were silent.

Action Zone Theory, Target Students and Science Classroom Interactions

Introduction

This study was a component of an ongoing study of classroom interactions in science classrooms (Jones, 1987, 1989a, 1989b). Previous studies examined sex differences in student-teacher interactions, gender representations of classroom displays, and gender equity as a function of teacher experience.

Several studies have reported the influence of a few "target students" who dominated classroom interactions and received a disproportionate amount of the teacher's attention. Sadker and Sadker (1985) reported in their study of 100 fourth, sixth and eighth grade classrooms, that a few salient students received proportionately more than three times the number of interactions than their classmates. This study also reported that 25% of all students did not participate in the classroom interactions at all.

Tobin and Gallagher (1987) also reported that a small number of students (usually male) dominated interactions in Australian high school science classes. Two types of target students were identified in the study: those students who tended to self-initiate classroom interactions, and those students who were selected by the teacher for interactions. Tobin and Gallagher also reported that teachers tended to direct higher cognitive level questions to the target students, leaving the lower level questions for the rest of class. Differential interaction patterns raises serious questions about the equity of instruction and opportunities for learning to occur.

Another study by Tobin (1988) also reported the presence of target students in 34 of the 36 classes examined. This study utilized teacher and student interviews, observations, student achievement and a student questionaire. The results indicated that target students tended to be higher achieving students, usually male, and target students one year usually continued to be target students in subsequent years.

The seating patterns of classrooms has been associated with differential communication patterns. Action zone theory suggests that where a student sits in the classroom determines how much interaction the student will have with the teacher (Saur, Popp, & Isaacs, 1984). Adams and Biddle (1970) observed 32 mathematics and social studies classes and reported that most of the verbal interaction came from students seated in the front row and center seats of other rows. They called this t-shaped area of disproportionate interactions the "action zone." Adams and Biddle suggest that the students who occupy these seats in the action zone receive more interactions because they tend to be in the teacher's immediate view. Good and Brophy (1980) also reported that students in the front and center of the classroom tended to interact more with the teacher than did students on the sides or back of the classroom. Koyeya (1976) reported a triangle of participation for university students that extended across the front row and ended at the middle seat of the middle row, and that students categorized as high verbalizers tended to exhibit higher rates of verbalization when seated centrally than when seated noncentrally. Low verbalizers tended to remain low verbalizers no matter where they were seated in the classroom. For at least some students, location in the classroom influences their patterns of communication.

Tobin and Gallagher (1987) reported that target students in their study tended to be seated in a central position, which facilitated good eye contact with the teacher. Tobin and Gallagher further cited an example of a student "Anna" who: "seated herself opposite the teacher so that she had good eye contact with him. This provided her with numerous opportunities to initiate discussion and to use nonverbal cues to indicate to the teacher that she wished to contribute to discussion" (p. 70). In the Tobin and Gallagher study, a teacher indicated in an interview that she failed to call on two students because these students were seated at the periphery of her vision.

Not all researchers have succeeded in finding a T-shaped action zone in classrooms. Delefes and Jackson (1972) observed a fifth grade language arts and an eighth grade social

studies class for the presence of an action zone. The investigators reported that they did not find evidence of a front and center action zone. Another study by Saur, Popp and Isaacs (1984) investigated the action zone theory with hearing-impaired students in mainstreamed classes. Their results indicated that action zone patterns do not exist in all classrooms. They reported that in the two classes in which an action zone was found, the instructor tended to stand behind a lectern. The researchers suggested: "the action zone phenomenon is produced by the natural tendency to focus attention on the perceptual field directly in front of an individual, the instructor in this case" (p. 24).

The purpose of this investigation was to examine classroom interaction patterns: (a) to see if target students could be identified; (b) to examine sex differences in target students; (c) to determine if target students were seated in an "action zone" or ("t-zone") within the classroom; (d) to determine whether target students were selected by the teacher or whether they self-selected their target status and; (e) to see if target students received more instances of sustaining feedback or casual conversation.

Methodology

Subjects

Teachers were selected from a pool of science teachers who volunteered to be observed. Only classes that involved whole class interactions were used. Those classes that were involved in laboratory activities where the students moved around were not used. Twenty-eight physical science (10 male and 18 female) teachers and twenty-eight chemistry teachers (6 male and 22 female) were observed for one class period. Teachers were notified the night before the observation took place that they were going to be observed and teachers were not informed of the exact nature of the hypotheses investigated. The study involved 1245 students from schools located in four eastern North Carolina counties.

Observations

An observer recorded every interaction that occurred between a teacher and a student, using a modified version of the Brophy-Good Teacher-Child Dyadic Observation Instrument (Brophy & Good, 1969). This instrument involves using 43 categories to record classroom interactions.

The Brophy-Good Teacher-Child Dyadic Observation Instrument was used in each class for an observation period of 30 minutes. Seating charts were made using a numbering system for each student, indicating student sex and location in the classroom. Each student was coded into a seating location as either in the t-zone or out of the t-zone (Figure 1). Audio recordings were made, transcribed and used to verify the coding of interactions.

All observations were made by the investigator with a second observer present and coding for three classes as a check on observer reliability. The intercoder reliability was .79.

Target students were operationally defined as those students in each class who scored more than one standard deviation above the class mean for total interactions. The mean number of target students per class session was 3.3 with a range from one target student to maximum of five.

Limitations

The observation instrument limited the types of interactions that could be recorded in the study. Only those interactions that occurred between the teacher and an individual student were recorded. If a student raised his or her hand to respond, but the teacher failed to call on the student, the hand raising was not recorded. Nonverbal interactions were also not recorded.

The different types of classes (physical science and chemistry) were not analyzed due to evidence from other studies (Jones, 1987) that there are no significant gender differences in interactions by class subject. However, this study is limited to two types of science classes and other subjects may not yield similar results.

Analysis

The frequencies for the categories of direct questions, student initiated interactions, sustaining feedback, and casual conversation were obtained. In addition, all interactions were combined and analyzed to represent the total number of interactions that occurred in the classroom for each student. The variables were analyzed using nested analysis of variance. Teacher sex is nested within each class session.

In order to examine the hypothesis that target students are seated in the action zone, the interaction of target student by t-zone was examined.

Results and Discussion

The analysis of variance for total interactions revealed significant main effects for student sex and target students (Table 1). Significant differences between target students and non-target students were found for student initiated questions, direct questions, sustaining feedback and conversation (Table 2).

Target Student Status

The results of this study indicate there are significant differences in the interactions of target students when compared to non-target students for total interactions. Target students (N= 186) had a mean of 16.68 interactions per class, whereas non-target students (N= 1058) had a mean of 3.85 interactions (Table 2).

Over all observations, there were 29.3% silent students, with no class interactions. The mean number of silent students per class was 6.0, with a range of 0 silent students to 64% silent.

Sex Differences

There were significant main effects for student sex for total interactions. Overall, male students had significantly more interactions ($\bar{X}$= 6.84) than female students ($\bar{X}$= 4.73). It was interesting to note however, that there was no significant student sex by target status interaction. Although there were more male target students than female target students, the female target students averaged more interactions per class session than the male target students (Table 3).

The T-Zone or Action Zone

Based on the literature, it was hypothesized that target students would tend to be seated in the t-shaped action zone within the classroom. An examination of the t-zone by target student interaction revealed that there is no significant relationship between being a target student and sitting in or out of the t-zone (Table 1). In addition, the analysis of variance indicated that no t-shaped action zone existed across the 56 classes examined in the study. This is in direct contrast to the findings of Adams and Biddle (1970) and Koyeya (1976).

The presence or absence of an action zone may be affected by who determines the seating for students. Student-selected seating may contribute to the likelihood of finding an action zone. Those students who like to contribute to class discussions may seat themselves in the front and center of the classroom. When the teacher determines the seating pattern, there may be other factors that determine where a student sits, such as mixing sex and race or controlling discipline.

Although this study did not find evidence of a t-shaped action zone, other action zones may exist. It does seem likely that interactions would originate within a teacher's field of vision. Where the teacher stands in the classroom may affect the presence or absence of an action zone. If teachers walk around while carrying out whole class instruction, the field of immediate view would constantly be changing, and new students would become involved in interactions. The action zone itself may be a dynamic field dependent on the location of the teacher in the classroom.

There may be something unique to science teaching that contributed to the lack of a

t-shaped action zone. Science teachers typically utilize demonstrations, laboratories and small group investigation and may therefore be less stereotypic when carrying out whole class instruction. In the present study, 67% of all teachers lectured and 33% used demonstrations, laboratories, or seatwork. Various teaching strategies and styles may alter the class structure and the interaction patterns.

Target Status: Self-Selected or Student-Selected?

Tobin and Gallagher (1987) reported the existence of two types of target students, self-selected and teacher selected. One of the objectives of this study was to determine whether target students were selected by the teacher or whether the students self-selected their target status.

Two of the categories of the Brophy-Good instrument allow for a determination of the categories of target status. The category "student-intiated interactions" indicates that students raised their hand and initiated an interaction sequence. "Direct questions" is coded when the teacher calls directly on a student without waiting for students to raise their hands or volunteer. The results of these two categories are shown in Table 2. Target students averaged 1.13 student-initiated questions compared to 0.23 initiated questions from non-target students. This is a highly significant difference ($p < .0001$). Target students tended to ask almost five times as many questions of the teacher as non-target students.

Target students were asked an average of 1.67 direct questions compared to 0.51 for non-target students ($p < .0001$). Teachers tended to directly ask target students over three times as many questions as non-target students. This suggests that the teacher is having a role in determining who is a target student.

The magnitude of the difference between between target and non-target students for direct questions (three times) and student-initated questions (five times) reveals that the role of the student in determining target student status may be stronger than the role of the teacher. Good, Sikes and Brophy (1973) have suggested that for gender differences in interactions, teachers react to demands made on them by male and female students. A similar process may be occurring for target students. Teachers may be responding to the demands made on them by students, rather than teachers selecting target students for special attention.

Sustaining Feedback

Not only did target students initiate more interactions; they also received significantly more sustaining feedback than non-target students ($p < .0001$). Tobin (1988) reported that target students tend to be higher achieving students and are more willing to answer difficult questions. It is plausable that target students receive higher quality feedback because teachers perceive a difference in ability and are attempting to maintain a high quality of discussion by sustaining the interaction rather than terminating it. The willingness of target students to answer more difficult questions may also relate to their recieving higher quality of feedback.

Teachers may be communicating their expectations regarding ability through sustaining feedback. Sustaining feedback tends to continue and prolong interaction, causing the student to rethink responses by providing clues. It seemed that when teachers used sustaining feedback they were communicating to the student that they believed that the student really knew the answer and just needed some help finding the correct response.

Conversation

Target students also received more instances of teacher afforded private conversation. Most of the teachers in the study were very formal in their teaching style and presentations and only a few instances of conversation occurred during the observations. Target students received an average of 0.07 instances of private conversation from their teacher, whereas non-target students received an average of 0.03 instances of private conversation per observation period.

All interactions recorded as conversation were by definition, teacher afforded. Teachers

selected target students significantly more often for private conversation ($p < .008$). The differences for target and non-target student interactions for conversation and the variable direct questions provide evidence that teachers are not just responding to the demands made on them by target students; rather that they are intentionally giving target students more attention.

Further Discussion

Target students typically have more confidence than non-target students. Tobin (1988) reported that target students revealed during interviews that they liked to answer questions in class, that they found participating in whole class discussions was a way of getting feedback on whether or not their thoughts and answers were correct, and they often liked to answer to impress their peers or the teacher with their understanding of the material.

Having target student status may not however, be to the benefit of the student. Tobin (1988) interviewed target student peers and teachers and reported that students stated that they did not like target student domination of class discussions, found target students very competitive and "disliked them for the public manner in which they flaunted their knowledge." Tobin indicated that target students were alienated from their peers. In addition, Tobin reported that non-target students liked seeing target students make errors in class. Whatever benefit target students gain from having more interactions in the classroom, must be weighed against the social detriment of being a target student.

From the teacher's perspective, target students may be an asset to keeping the class moving at a smooth pace. Teachers have indicated that they call on target students because they can clarify questions and elaborate on concepts (Tobin, 1988). However, if target students have a deeper understanding of the material being taught, and the teacher uses the target students in the class to make judgments about the level of understanding and the pace of instruction, the teacher may be getting biased feedback from the class. The result may be that teachers use a pace and conceptual level that is beyond most students.

Implications

The relationship of whole class interactions to student cognitive development and achievement has not been fully explored. It seems likely that interacting during classroom discusions would increase achievement, however, there is little research evidence to support this hypothesis. The fact that nearly 30% of all students are completely silent is striking. There is little evidence to suggest that failing to participate in classroom interactions is detrimental. There are many very quiet students who are also high achievers. Other studies have shown that target students tend to have high achievement, but it isn't clear whether students become target students because they have higher achievement (and therefore more confidence), or whether the process of being a target student results in higher achievement.

From an equity perspective, there is concern that a small proportion of students receive five times more interactions than the rest of the class. The fact that teachers have greater expectations for target students raises further concern when not all students are having equal opportunities to participate in class. When the inequity is carried out over many years, because target students tend to continue to be target students in subsequent years (Tobin, 1988), the participation discrepancy is compounded.

The inequitable participation of women in science classes may be exacerbated by the dominating effect of large proportions of male target students. For public schools in a democratic society, it is critical that educators ensure equitable opportunity for learning to take place. If, as in the case of many quiet students, they choose to refrain from participating, the issue changes from not having an opportunity, to actively choosing not to utilize the available opportunity to participate.

Further research is needed to investigate the role of classroom interactions on student achievement. It would be interesting to know why silent students fail to participate, and how the lack of participation influences learning. Additional research on action zone theory may

the lack of participation influences learning. Additional research on action zone theory may provide additional insight into patterns of participation and the relationship of seating patterns to participation in class.

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Table 1
Analysis of Variance for Total of Student-Teacher Interactions

Source	df	MS	F	p
Teacher Sex	1	129.46	0.69	.4083
Session(Teacher Sex)	54	197.05		
Student Sex	1	113.87	4.77	.0334*
Target Student	1	17233.62	721.29	.0001***
Tzone	1	1.70	0.07	.7906
Student Sex*Target	1	30.58	1.28	.2629
Student Sex*Tzone	1	7.87	0.33	.5682
Target*Tzone	1	1.51	0.06	.8022
Student Sex*Target*Tzone	1	47.31	1.98	.1651
Stu Sex*Session(Teacher Sex)	54	23.89		

*p< 0.05
***p< .001

Table 2
Mean Number of Interactions for Target and Non-target Students

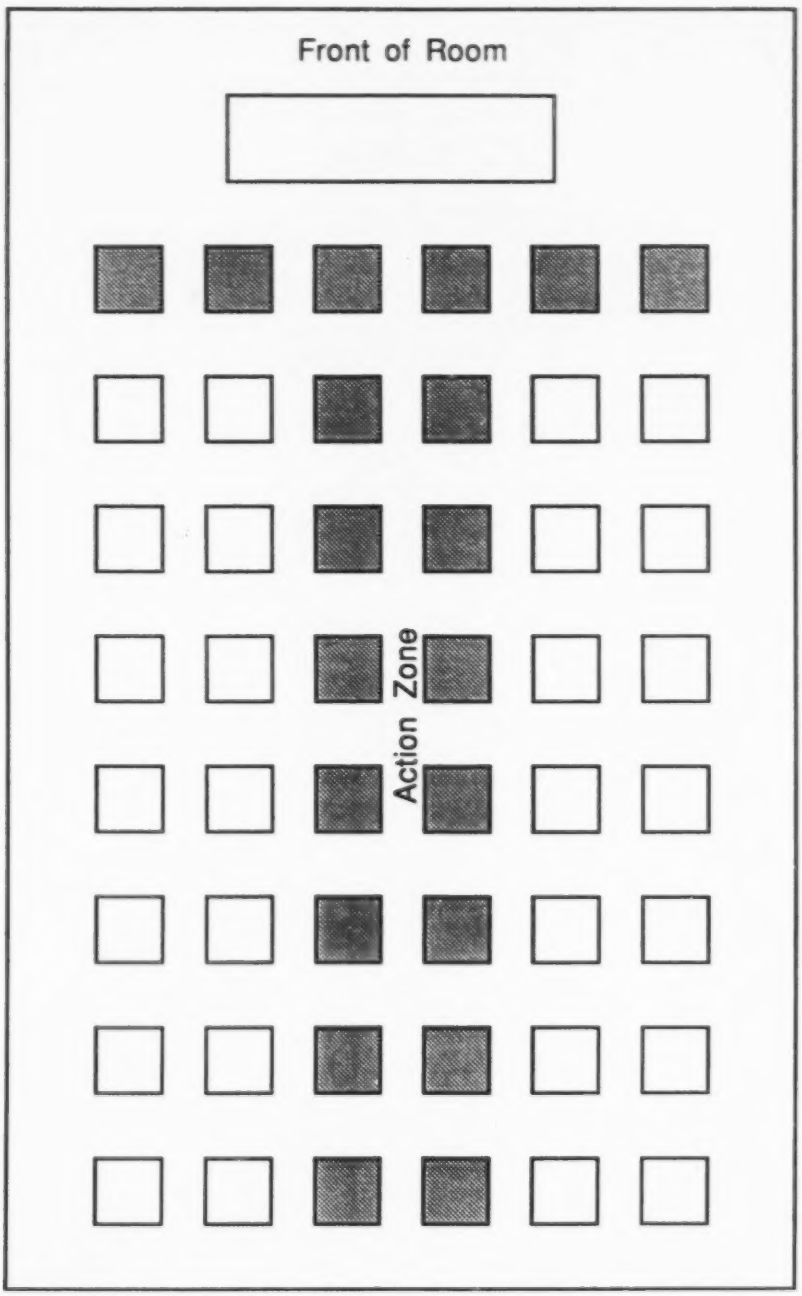
Variables	Target N=186 X̄ (SE)	Non-Target N=1059 X̄ (SE)
Total	16.68(.31)	3.85(.03)***
Student Initiated	1.13(.06)	0.23(.02)***
Direct Questions	1.67(.06)	0.51(.03)***
Sustaining Feedback	0.57(.03)	0.06(.01)***
Conversation	0.07(.01)	0.03(.01)*

*p< 0.05
***p< .001

Table 3
Mean Interactions by Male and Female Target and Non-Target Students

Student Sex	Target Status	N	Mean Interactions
Female	Target	73	0.64
Male	Target	113	0.52
Female	Non-Target	561	0.05
Male	Non-Target	497	0.08

Figure 1. Seating Diagram Showing the Action Zone



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